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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	H. OGAWA et al.
Serial No.:	Not Yet Assigned Division of Application Serial No. 08/176,689
Filed:	Even Date Herewith
For:	DISK DRIVE APPARATUS AND METHOD OF MOUNTING SAME
Art Unit:	3729 (Anticipated)
Examiner:	C. Arbes (Anticipated)

CLAIM FOR PRIORITY

Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

March 21, 2001

Sir:

Pursuant to 35 USC 119 and 37 CFR 1.55, the applicants hereby claim the right of priority based on the following foreign applications filed in Japan:

Application No. 2-331554 filed on November 28, 1990
Application No. 3-38385 filed on March 5, 1991

Certified copies of these foreign applications were filed on August 4, 1993, in application Serial No. 07/799,143 filed on November 27, 1991, the parent application of the present divisional application.

Respectfully submitted,

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#6 Pet 8/17/01

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	H. OGAWA et al.
Serial No.:	09/812,582
Filed:	March 21, 2001
For:	DISK DRIVE APPARATUS AND METHOD OF MOUNTING SAME
Art Unit:	2651
Examiner:	K. Wong

SUBMISSION OF ENGLISH TRANSLATIONS OF JAPANESE PRIORITY APPLICATIONS

Assistant Commissioner for Patents
Washington, D.C. 20231

August 13, 2001

Sir:

Pursuant to 37 CFR 1.55(a)(4) and MPEP 201.15, attached hereto are English translations of Japanese application No. 2-331554 filed on November 28, 1990, and Japanese application No. 3-38385 filed on March 5, 1991, the Japanese priority applications of the above-identified divisional application, including statements that the English translations are accurate, to perfect the applicants' claim for priority.

Certified copies of Japanese priority application Nos. 2-331554 and 3-38385 were filed on August 4, 1993, in

application Serial No. 07/799,143, the grandparent application of the present divisional application.

Respectfully submitted,

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Attachments

DECLARATION

I, Kaoru Tasaka, a national of Japan, c/o Shoyo Naigai Patent Attorneys Office, Yokohama HS-Bldg. 7F, 9-10, Kitasaiwai 2-chome, Nishi-ku, Yokohama-shi, Kanagawa-ken, Japan, declare that I am familiar with both the English and Japanese languages, that I am the translator of the attached document, that to the best of my knowledge and belief the attached document is a true and accurate translation of Japanese Patent Application Serial No. 2-331554 filed on November 28, 1990, and further that these statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Dated this 9th day of November, 1994

Kaoru Tasaka

PATENT OFFICE
JAPANESE GOVERNMENT

This is to certify that the annexed is a true copy of the following application as filed with this Office.

Date of Application	:	November 28, 1990
Application number	:	Patent Appln. No. 2-331554
Applicant(s)	:	Hitachi, Ltd.

October 9, 1991

Commissioner,
Patent Office Wataru Fukazawa

Certificate Issuance No. 3-46537

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PATENT APPLICATION(7)

November 28, 1990

Commissioner
Patent Office

Title of the Invention

INFORMATION PROCESSING SYSTEM

Number of Claims 16

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List of Attached Documents
(1) A specification
(2) Drawings
(3) A power of attorney
(4) A duplicate of application

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SPECIFICATION

1. Title of the Invention

INFORMATION PROCESSING SYSTEM

2. What is Claimed is:

1. A method of mounting a disk drive apparatus to a board, comprising the steps of:

providing, on a surface of a disk drive, a connecting unit which is in contact with an external circuit, and

providing, on said board, a terminal unit which corresponds to said connecting unit and is electrically connected with said external circuit; and

directly connecting said connecting unit with said terminal unit to connect and secure said disk drive to said board.

2. A method of mounting a disk drive apparatus to a board as defined in claim 1, in which said connection of said connecting unit with said terminal unit is performed by using the Dual-in-line package (DIP) mounting method.

3. A method of mounting a disk drive apparatus to a board as defined in claim 1, in which said connection of said connecting unit with said terminal unit is performed by using the plastic leaded chip carrier (PLCC) mounting method.

4. A method of mounting a disk drive apparatus to a board as defined in claim 1, in which said connection of said connecting unit with said terminal unit is performed by using the Quad Flat Package (QFP) mounting method.

5. A method of mounting a disk drive apparatus to a board as defined in claim 1, in which said connection of said connecting unit with said terminal unit is performed by using the Pin Grid Array (PGA) mounting method.

6. A method of mounting a disk drive apparatus to a board as defined in claim 1, in which said connection of said connecting unit with said terminal unit is performed by using the microtribeam mounting method.

7. A method of mounting a disk drive apparatus to a board as defined in claim 1, in which said connection of said connecting unit with said terminal unit is performed by using the multi-contact rotary connecting method.

8. A method of mounting a disk drive apparatus to a board as defined in claim 1, in which a power supply terminal and a ground terminal which form said connecting unit and said terminal unit are disposed in positions which are in a diagonally opposed relationship to each other.

9. A method of mounting a disk drive apparatus to a board as defined in claim 1, in which said connecting unit has a plurality of terminals, a spacing between the terminals being an integer multiple of 0.254 mm.

10. A disk drive mounting socket comprising:

a socket portion for supporting a disk drive;

a lead portion which connects with the disk drive which is supported by the socket portion; and

a terminal unit which is electrically connected with the lead portion and connects with circuits on a board.

11. A disk drive mounting socket as defined in claim 10, in which said socket portion has a vibration absorbing member at a portion which contacts with said disk drive.

12. A disk drive apparatus which is connected with an information processing system, the information processing system utilizing a disk drive apparatus, comprising:

a disk drive;

connecting means for connecting said disk drive with said information processing system; and

interface means for controlling said disk drive in response to a control signal, a data bus signal and an address bus signal which are generated and inputted by said information processing system via said connecting means.

13. A disk drive apparatus as defined in claim 12, in which said connecting means can be connected with a connector of a memory card of said information processing system.

14. A method of mounting a disk drive apparatus to a board as defined in claim 2, in which a plurality of disk drive apparatuses are disposed by providing said connecting unit of the DIP mounting method with a through-hole into which the other connecting unit of the DIP mounting method can be inserted and inserting said connecting unit of the other disk drive apparatus into the through-hole.

15. A disk drive apparatus in which a ground signal line is omitted from signal lines for a standard interface for external connection.

16. A disk drive apparatus as defined in claim 15, in which the signal lines for the standard interface of said disk drive comprise a control signal, a data bus and a power supply line.

3. Detailed Description of the Invention

(Industrial Field of Utilization)

This invention relates to a disk drive apparatus and a mounting method thereof.

(Prior Art)

Conventionally, in order to mount a disk drive apparatus within an information processing system, it is necessary to connect the disk drive apparatus with a unit mounted on a printed wiring board or to connect the disk drive apparatus with a power supply. In this case, in order to reduce the number of cables, there has been utilized a printed wiring board which is provided with a connector electrically connected with the disk drive apparatus and a connector for inputting and outputting electrical signals inputted and outputted to and from the disk drive apparatus via the connector to and from external devices of the printed wiring board.

The prior art will be described with reference to FIG. 18.

A plurality of disk drive apparatuses 32 are secured by screws or the like.

In the vicinity of the disk drive apparatus 32 mounted on a printed circuit board 31, a connector 33, which electrically connects the printed wiring board 31 and the disk drive apparatus 32, is mounted. A cable 36 having a connector from the disk drive apparatus 32 is connected with the connector 33.

A connector 34 for external connection is mounted on the printed wiring board 31 at one end thereof.

The printed wiring board 31 has such an outer dimension that the board can be mounted upon a printed wiring board mounting unit 40.

A connecting printed wiring board 41 is disposed in the rear side of the board mounting unit 40.

The connecting printing wiring board 41 is provided with circuits for power supply and signals, and is also provided with connector 42 which is connected to the connector 34 of the printed wiring board 31.

The printed wiring board mounting unit 40 is usually provided with guiding grooves 43 for guiding and positioning the printed wiring boards 31 so that the boards 31 can be positively secured.

This mounts the printed boards 31 to the printed board mounting unit 40 simultaneously with the electrical connection with the connecting printed board 41.

Accordingly, the disk drive apparatus 32 is connected with an external device via a connector and a printed circuit on the printed wiring board. A cable which directly connects the external device with the disk drive apparatus is thus not necessary.

Such a prior art is described in Japanese Unexamined Patent Application No. Hei 1-112586.

(Problems that the Invention Is to Solve)

However, according to the above-described prior art, the number of cables which connect a group of disk drive

apparatuses 32 on the printed wiring board 31 with an external device has been reduced by mounting a plurality of disk drive apparatuses 32 on the same printed wiring board 31 and by connecting the disk drive apparatus 32 with the external device via the connector 34 provided on the printed wiring board 31.

Accordingly, the printed wiring board 31 is used only for mounting the disk drive apparatus 32.

There is also a problem that the group of disk drive apparatuses 32 is brought into contact with the printed wiring board 31 by the cable 36 attached to the connector of the disk drive apparatus 32 and the connector 33 on the printed wiring board 31.

In other words, the connector portion and cable connection occupies a greater area of the mounting board or the disk drive in the prior art even if the disk drive is miniaturized. The miniaturization of the disk drive has not been effective.

Mounting of the disk drive apparatus 32 and information processing unit, including a CPU and memory elements to the same board has not been considered.

It is an object of the present invention to provide a method of mounting a disk drive apparatus to a printed wiring board in the same manner as electronic components together with the other information processing unit so that the mounting area of the disk drive apparatus is reduced.

It is another object of the present invention to provide a disk drive apparatus which can be used like a memory card.

(Means for Solving the Problems)

To accomplish these objects, there is provided, as one aspect of the present invention, a method of mounting a disk drive apparatus to a circuit board, comprising the steps of providing the disk drive apparatus with a connecting unit which is in contact with an external circuit and providing the circuit board with a terminal unit which corresponds to said connecting unit and is electrically connected with said external circuit, and directly connecting said connecting unit with said terminal unit to connect and secure said disk drive apparatus to said circuit board.

It is preferable that connection of the connecting unit with said terminal unit is achieved by DIP, PLCC, QFP, PGA, microtribeam or multi-contact rotary connection mounting method.

It is preferable that a power supply terminal and a ground terminal, which are formed in said connecting unit and said terminal unit, are disposed in positions which are in a diagonally opposed relationship.

It is preferable that the connecting unit have a plurality of terminals, the spacing between the terminals being an integer multiple of 0.254 mm.

If the DIP package design is adopted, there is provided a method of mounting a disk drive apparatus in which said connection of said connecting unit with said terminal unit is performed by a DIP mounting method and in which a plurality of disk drive apparatus are stacked on top of each other by inserting said connecting unit of an upper disk drive apparatus into through-holes provided on the connecting unit of the other lower disk drive.

As another aspect of the present invention, there is provided a disk drive mounting socket comprising a socket portion for supporting a disk drive, a lead portion which is connected with said disk drive supported by said socket portion, and a terminal unit which is electrically contacted with said lead to connect with circuits on a board.

In this case, it is preferable that the socket have a vibration absorbing member at a portion which contacts with said disk drive apparatus.

As a further aspect of the present invention, there is also provided a disk drive apparatus which is connected with an information processing system, comprising a disk drive apparatus, a connecting means for connecting said disk drive with said information processing system, and an interface means for controlling said disk drive apparatus in response to a control signal, a data bus signal and an address bus signal which are generated and inputted by said information processing system via said connecting means. Furthermore,

an information processing system including this disk drive apparatus is provided.

In this case, it is preferable that said connecting means can be connected with a connector of a memory card of the information processing system.

As a further aspect of the present invention, there is provided a disk drive apparatus in which a ground signal line is omitted from signal lines for a standard interface for external connection.

In this case, it is preferable that the signal lines for the interface of the disk drive apparatus include a control signal line, a data bus and a power supply line.

The aspects of the present invention will be described in more detail.

The present invention adopts a method which is similar to a method of mounting electronic components to a board.

A package design which is used for packaging electronic components such as ICs is adopted as the package design of the disk drive. The package designs of the electronic components are mainly classified into two package designs such as a DIP package which is pin insertion mounted and a QFP package which is surface mounted. Both of these two package designs can be used for the disk drive apparatus.

The board on which the disk drive apparatus will be mounted is provided with contact terminals to said package, which are printed in a similar manner to the printed wiring on the board.

Electrical connection between a disk drive and an information processing unit, when they are mounted on the same board, is enabled by connecting the leads of the disk drive with the contact terminals on the board.

It is expected that a requirement to replace the disk drive will arise after mounting to the board. In order to fulfill such a requirement, a disk drive mounting socket is provided between the disk drive and the board to make it easier to replace the disk drive after mounting. The mounting socket is comprised of a vibration absorbing member made of a elastomer or the like so that vibrations/impacts applied to the disk drive are reduced.

In order to enable a disk drive to be carried and to be used like a memory card, a disk interface control unit is provided in the disk drive so that the disk drive can be operated with the same conventional interface for card memory.

(Operation)

Electrical connection to the contact terminals is made possible by using printed wiring on the board which is the same wiring used for connection of the CPU and memory devices, since the disk drive can be mounted to the same board as the CPU and the memory devices.

The disk drive is provided on the sides thereof with lead portions for electrical connection with an external device.

The lead portions of the disk drive can be contacted with contact terminals on the board without using any cables. Prior art members for securing the disk drive, such as screws, are eliminated. Portability of the dick drive is enhanced by using a socket when the disk drive is mounted to the board. The socket also functions as a vibration absorbing member.

The disk drive can be used like a memory card by incorporating a disk interface control into the disk drive to deal with a system bus.

At the DIP type lead portion, the arrangement of a power supply terminal and a ground terminal in a diagonal relationship with each other enables the use of an electronic component (TTL) image and decreases the rate of occurrence of miswiring of the power supply line.

Laminated structure or direct contact of a disk drive with other electronic components is made possible by providing the lead portions of the disk drive with insertion portions.

An information processing system to which the disk drive is connected can read and write data to and from the disk drive apparatus in response to a control signal, an address signal and a data bus signal, similarly to a memory card.

(Embodiments)

Embodiments of the present invention will be described with reference to the drawings.

The present invention is not limited to only the following embodiments.

EMBODIMENT 1

FIG. 1 is a perspective view showing an embodiment of a small hard disk drive apparatus (hereinafter referred to as SHDD) 1 which is mounted on a circuit board.

An information processing unit 5 comprising a CPU element 3, a memory element 4, a device controller 6 and so on is formed on the circuit board 2. These components are electrically connected with each other by board wiring 8. In the present embodiment, the SHDD 1 is mounted on the circuit board 2. In other words, both the information processing unit 5 and the SHDD 1 are provided on the same circuit board.

Contact terminals 9 which are extensions of the board wiring 8 are provided on the periphery of the SHDD 1 on the circuit board 2. On the other hand, lead portions 11 are provided in positions corresponding to the contact terminals 9 on the SHDD 1. The SHDD 1 is electrically connected with the CPU element 3, the memory element 4 and so on via the contact terminals 9 and the lead portions 11.

The SHDD 1 and the lead portions 11 are shown in detail in FIG. 2.

The SHDD 1 includes therein a magnetic disk 12, a magnetic disk rotation controller 13, a magnetic head 14, a magnetic head drive controller 15 and a disk drive control circuit 10.

The lead portions are provided on both the right and left sides of the SHDD 1.

In this embodiment, DIP (Dual-in-line Package) lead portions 111 are adopted as the lead portions 11.

As described above, inputting and outputting from and to the information processing unit 1 and so on is carried out via the DIP type lead portions 111.

The spacings between the DIP type lead portions 111 of the present embodiment are 100MIL (2.54mm) so that they are equal to those between through-holes of the punched circuit board. Although it is preferable to preset the lead spacing to an integer multiple of 10MIL (0.254mm), the lead spacing may be preset to a desired pitch without being limited to this value.

Through-holes are provided on the circuit board 2 as contact terminals 9 in positions corresponding to the DIP type lead portions 111.

Mounting of the SHDD 1 is carried out by inserting the DIP type lead portions 111 into the through-holes which are the contact terminals 9.

In other words, insertion of the DIP type lead portions 111 into the through-holes enables the SHDD 1 to be fixed onto the circuit board 2 and to be electrically connected

with the information processing unit 5 similarly to conventional DIP type electronic components.

EMBODIMENT 2

This embodiment is substantially identical to the first embodiment in structure and has a feature that a power source pin 16 and a ground pin 17 are in a diagonal relationship as shown in FIG. 3.

The arrangement of the power source pin and the ground pin has heretofore been uniquely preset in TTL (transistor transistor logic) devices. The frequency of misconnection occurring when the SHDD 1 is mounted on the circuit board 2 can be reduced by adopting such a pin arrangement with the present invention. Connectors other than the DIP type are also applicable.

EMBODIMENT 3

This embodiment is substantially identical to the first embodiment in structure and has a feature that PLCC (plastic leaded chip carrier) type lead portions 112 are adopted as the lead portions 11 as shown in FIG. 4. The PLCC type lead portions 112 are provided on the lower surface of the SHDD 1 along the outer periphery thereof.

The SHDD 1 is electrically connected with the information processing unit 5 via the PLCC type lead portions 112 and the contact terminals 9 on the circuit

board 2. The SHDD 1 is mounted on the circuit board 2 by a technique identical to the PLCC mounting technique.

EMBODIMENT 4

This embodiment is substantially identical to the first embodiment in structure and has a feature that QFP type lead portions 113 are adopted as the lead portions 11 as shown in FIG. 5. The QFP type lead portions 113 are provided on the lower surface of the SHDD 1 along the outer periphery thereof.

The SHDD 1 of the present embodiment is mounted on and connected with the circuit board 2 using technique identical to the PLCC type mounting technique.

EMBODIMENT 5

This embodiment is substantially identical to the first embodiment in structure and has a feature that PGA (pin grid array) type lead portions 114 are adopted as the lead portions 11 as shown in FIG. 6.

The PGA type lead portions 114 are disposed on the lower surface of the SHDD 1.

The SHDD 1 of the present embodiment is mounted on and connected with the circuit board 2 by inserting the PGA type lead portions 114 into the through-holes provided on the circuit board 2 as the contact terminals 9.

As described above, in the SHDD 1 which is mounted on the circuit board 2, any designs for contacting with the

circuit board, which are used for conventional electronic components may be adopted.

EMBODIMENT 6

This embodiment is substantially identical to the first embodiment in structure and has a feature that the lead portions 11 and contact terminals 9 comply with the connector having SCSI (Small Computer system interface) specifications.

The lead portions 11 of the SHDD 1 can be provided in a desired arrangement at desired positions. In the present embodiment, the SHDD 1 is provided with lead portions 115 which comply with the SCSI specifications as shown in FIG. 7. On the other hand, a SCSI connector 92 is provided as the contact terminals 9 on the circuit board 2. The pin arrangement of the SCSI specification lead portions 115 is shown in FIG. 8.

Mounting of the SHDD 1 is completed by directly connecting the SCSI specification lead portions 114 to the SCSI connector 92.

The present embodiment has been described with reference to SCSI used as a standard interface. The present invention is not limited to SCSI. It is possible to make the lead portions 11 comply with other interface specifications such as ESDI.

It is also possible to make the number of connecting signal lines between the SHDD 1 and the information

processing unit 5, that is the number of pins of the lead portions 11 set to eighteen (18), by omitting a ground signal, as shown in FIG. 9.

In this case, the eighteen (18) connecting signals include nine (9) control signals (ATN, BSY, ACK, RST, MSG, SEL, C/D, REQ, I/O) and nine (9) data bus signals (8 bit data + 1 bit parity).

In a case of introducing power source lines (power supply and ground) via the lead portions 11, the number of connecting lines may be twenty (20).

EMBODIMENT 7

The structure of the SHDD 1 of the present embodiment will be described with reference to FIG. 10.

The SHDD 1 comprises a built-in disk interface controller 72 and a disk drive control circuit 10. In this case, the disk drive control circuit 10 includes a read/write circuit, a magnetic head positioning control circuit and so on. The SHDD 1 also includes a connection detecting unit 18 for detecting the connection state of the SHDD 1.

The built-in disk interface controller 72 of the present embodiment has address bus, data bus and memory control signals as connecting signals between the information processing unit 5. This enables the SHDD 1 to be used like a memory card.

The connection detecting unit 18 has connection detecting signals for confirming the connection between the SHDD 1 and the circuit board 2. The connection detecting signals are outputted via a connecting unit 120 and include an SHDD identification signal and a connection confirmation signal.

The SHDD identification signal corresponds to an identification signal of RAM or ROM of the memory card and is identical to the RAM identification signal in the case of SHDD connection.

In this embodiment, a microtribeam type connector 121 which is used for mounting the memory card is adopted for the connecting unit 120 between the SHDD 1 and an external circuit, that is, a portion corresponding to the lead portions 11 of the first embodiment. The microtribeam type connector 121 is illustrated in FIG. 11. Although not shown, a connector corresponding to the microtribeam type connector 121 is provided on the board on which the SHDD 1 is to be mounted.

Mounting of the SHDD 1 is completed by adapting the microtribeam type connector 121 of the SHDD 1 to the connector (not shown) provided on the circuit board.

At this time, the connection detecting unit 18 outputs the SHDD identification signal and the connection confirmation signal to the information processing unit 5 so that the connection is confirmed.

When writing data, the built-in disk interface controller 72 generates a disk access control signal and data, utilizing the address bus signal, the memory control signal and the data bus signal which are inputted via the connecting unit 120, and outputs them to the disk drive control circuit 10.

The disk drive control circuit 10 performs writing of data onto the magnetic disk 12 using the disk access control signal and the data.

Reading of the data is achieved by carrying out the reverse to the foregoing operation.

According to the present embodiment, operation control of the SHDD 1 is enabled by the data bus, the address bus and the control signals used in the memory card. That is, a system bus of an information processing system on which the SHDD 1 is mounted can be directly connected with the SHDD 1. Accordingly, connection of the SHDD 1 with computers having different disk drive connection specifications is possible via the system bus.

The design of the connecting unit 120 is not limited to only that described in this embodiment. The connecting unit 120 may be, for example, a multi-rotary contact type connector 122 as shown in FIG. 12.

EMBODIMENT 8

This embodiment has a feature that use of the SHDD 1 is enabled in both a disk mode and a memory card mode.

The structure will be described with reference to FIG. 13.

The SHDD 1 comprises a magnetic disk 12, a built-in disk interface controller 72, a connection detecting unit 18 of the SHDD 1 and a disk drive controller 10.

In the present embodiment, the SHDD 1 further includes a selecting circuit 19. A disk interface controller 71 is provided outside the SHDD 1.

The selecting circuit 19 selects one of either the disk interface controller 71 or the built-in disk interface controller 72 in response to an externally inputted mode switching signal to bring the SHDD 1 into the disk mode or the memory card mode, respectively.

The magnetic disk 12, the built-in disk interface controller 72, the SHDD connection detecting unit 18 and the disk drive control circuit 10 are identical to those of the embodiment 7.

Operation will now be described.

In the disk mode, the disk interface controller 71 is selected by the selecting circuit 19. An access to the magnetic disk 12 is performed in response to the disk access control signal and data which are outputs of the disk interface controller 71. On the other hand, in the memory card mode, the built-in disk interface control 72 is selected by the selecting circuit 19. An access to the magnetic disk 12 is performed in response to the disk access

control signal and data which are outputs of the disk interface control 72.

As described above, in the present embodiment, the disk drive can be used in either the disk mode or the memory card mode.

EMBODIMENT 9

This embodiment has a feature that the SHDD 1 is mounted on the circuit board by using an SHDD mounting socket 23.

The embodiment will be described with reference to FIG. 14.

The SHDD 1 of the present embodiment is designed with a PLCC type connecting unit shown in the embodiment 3, that is, the PLL type lead portions 112. The design of the connecting unit is not limited to only that shown in the drawing.

The SHDD mounting socket 23 secured on the circuit board 2 has such a design and a dimension that it can house the SHDD 1 therein and the socket 23 has contact terminals 9 corresponding to the PLL type lead portions 112. The SHDD mounting socket 23 is provided on the lower surface thereof with board mounting lead portions 51 for securing the SHDD mounting socket 23 on the circuit board.

The SHDD mounting socket 23 is preferably composed of a vibration absorbing member made of an elastic material so as to have a vibration absorbing capability.

The SHDD 1 is mounted on the circuit board by inserting the SHDD 1 into the SHDD mounting socket 23.

EMBODIMENT 10

Previously, the vibration absorbing capability was provided by using elastomers (rubber and the like) as means of securing the board, for example, screws.

In accordance with the present invention, the SHDD 1 is directly mounted onto the same circuit board as the information processing unit including CPU and the like. Accordingly, it is necessary to provide the vibration absorbing capability to the SHDD 1 in the position other than the portion where it connects with the circuit board.

In the present embodiment, the vibration absorbing capability is provided in the socket when the SHDD 1 is mounted upon the circuit board by using the socket.

The present embodiment will be described with reference to FIG. 15.

The SHDD mounting socket 23 is provided with dampers 50 made of leaf springs on the inner upper and lower sides thereof.

The SHDD 1 is supported and fixed by the dampers 50 in the SHDD mounting socket 23.

The SHDD mounting socket 23 is provided with board mounting lead portions 51 on the outer lower side thereof. The SHDD 1 is bonded and fixed to the circuit board by the lead portions 51. The leads 11 of the SHDD 1 are connected

with the board mounting lead portions 51 of the SHDD mounting socket 23 via lead lines 52.

The dampers 50 are not limited to only leaf springs, and may be an elastomer member 53 made of rubber and so on, as shown in FIG. 16.

Means for contacting the lead portions 11 of the SHDD 1 with the lead portions 51 of the SHDD mounting socket 23 is not limited to only the lead lines, and may be pressure contacts which are shown in FIG. 16. The SHDD mounting socket 23 on which the SHDD 1 is mounted can be considered as a single SHDD.

In this embodiment, vibrations and impacts on the circuit board can be absorbed between the mounting socket 23 and the SHDD 1.

EMBODIMENT 11

Lamination of the SHDD 1 is achieved as shown in FIG. 17 in this embodiment.

The SHDDs are provided with lead portions 11 which are identical to those of the embodiment 1. The lead portions 11 are DIP type lead portions 111 which are inserted into through-holes provided on the board. Each of the DIP lead portions 111 is provided with an insertion portion 24 having the same design as the through-hole to which one of the other DIP lead portions 111 can be inserted.

A plurality of SHDDs 1 are bonded with each other by the lead portions 11 by stacking one SHDD 1 on the other

SHDD 1 and inserting the DIP type lead portions 111 of the upper SHDD 1 into insertion portions 24 of the lower SHDD 1. This makes it possible to laminate and mount the SHDDs 1 on the circuit board.

Furthermore, the insertion portions 24 provided on the lead portions 11 may be used for insertion or connecting of electronic components which are required for insertion or removal of the SCSI termination resistors.

In the present embodiment, lamination of the SHDD 1 is possible. No additional area for mounting of an additional SHDD 1 is required and the mounting board can be effectively used. Although the SHDD 1 is mounted on the board so that the side of the SHDD 1 having the widest area comes into contact with the circuit board, the side of the SHDD 1 which contacts the circuit board is regulated only by provisions for the orientation direction of the SHDD 1 providing direction.

(Effect of the Invention)

As described above, in the present invention, it is possible to reduce the mounting area on the circuit board because a mounting method for electronic parts is adopted for mounting a disk drive apparatus on a circuit board.

Furthermore, since it is possible to mount the disk drive apparatus, the CPU elements, the memory elements and so on on a same circuit board, the disk drive apparatus and the CPU elements, etc. are not positioned vertically with

respect to one another, so that cables for connecting the disk drive apparatus with the CPU elements, the memory elements and so on are not required. Thus, the information processing system can be made smaller.

In addition, the disk drive apparatus can be easily detached/attached because the socket is used for mounting the disk drive apparatus on the circuit board. Moreover, since a vibration absorbing member such as an elastomer is used for the socket, the reliability of the information processing system in the case of being transported is improved.

It is also possible for the disk drive apparatus to be directly connected, or laminated with the other electronic parts.

The disk drive apparatus can be used as a memory card.

(Brief Description of the Drawings)

FIG. 1 is a general perspective view of an embodiment of the present invention;

FIG. 2 is a top view and side view of a disk drive apparatus in which a DIP type lead portions are adopted;

FIG. 3 is a pin arrangement view of the disk drive apparatus in which the DIP type lead portions are adopted;

FIG. 4 is a general perspective view of a disk drive apparatus in which a PLCC type lead portions are adopted;

FIG. 5 is a general perspective view of a disk drive apparatus in which a QFP type lead portions are adopted;

FIG. 6 is a general perspective view of a disk drive apparatus in which a PGA type lead portions are adopted;

FIG. 7 is a side view of a disk drive apparatus and a circuit board in which an SCSI type lead portions are adopted;

FIG. 8 is a pin arrangement of the SCSI connector;

FIG. 9 is a pin arrangement of the disk drive apparatus;

FIG. 10 is a block diagram of a disk drive apparatus which enables the use in memory image;

FIG. 11 is a general perspective view of a disk drive apparatus in which a microtribeam connector is adopted for a connecting unit;

FIG. 12 is a general perspective view of a disk drive apparatus in which a multi-contact rotary connector is adopted for a connecting unit;

FIG. 13 is a block diagram of a disk drive apparatus which enables the use in two modes of the disk drive apparatus and the memory image;

FIG. 14 is a general perspective view of the disk drive apparatus and its socket in which the PLCC type lead portions are adopted;

FIG. 15 is a top view and side view of the disk drive apparatus in which the DIP type lead portions are adopted;

FIG. 16 is a side view of an embodiment in which dampers are provided in the socket;

FIG. 17 is a explanatory view of an embodiment in which the disk drive apparatuses are laminated; and

FIG. 18 is a perspective view showing a prior art.

(Description of the Marks)

1: small hard disk drive apparatus

2: circuit board

3: CPU element

4: memory element

5: information processing unit

6: device controller

8: board wiring

9: contact terminal

10: disk drive control circuit

11: lead portion

12: magnetic disk

13: magnetic disk rotation controller

14: magnetic head

15: magnetic had drive controller

16: power source pin

17: ground pin

18: connection detecting unit

19: selecting circuit

23: SHDD mounting socket

24: insertion portion

31: printed wiring board

32: disk drive apparatus

33: connector

34: connector

36: cable having a connector

40: printed circuit mounting unit

41: connecting printed wiring board

42: connector

43: guide groove

50: damper

51: board mounting lead portions

52: lead portion

53: elastomer member

71: disk interface controller

72: built-in disk interface controller

91: through-hole

92: SCSI connector

111: DIP type lead portion

112: PLCC type lead portion

113: QFP type lead portion

114: PGA type lead portion

115: SCSI type lead portion

120: connecting unit

121: microtribeam type connector

122: multi-contact rotary connection type connector

FIG. 1

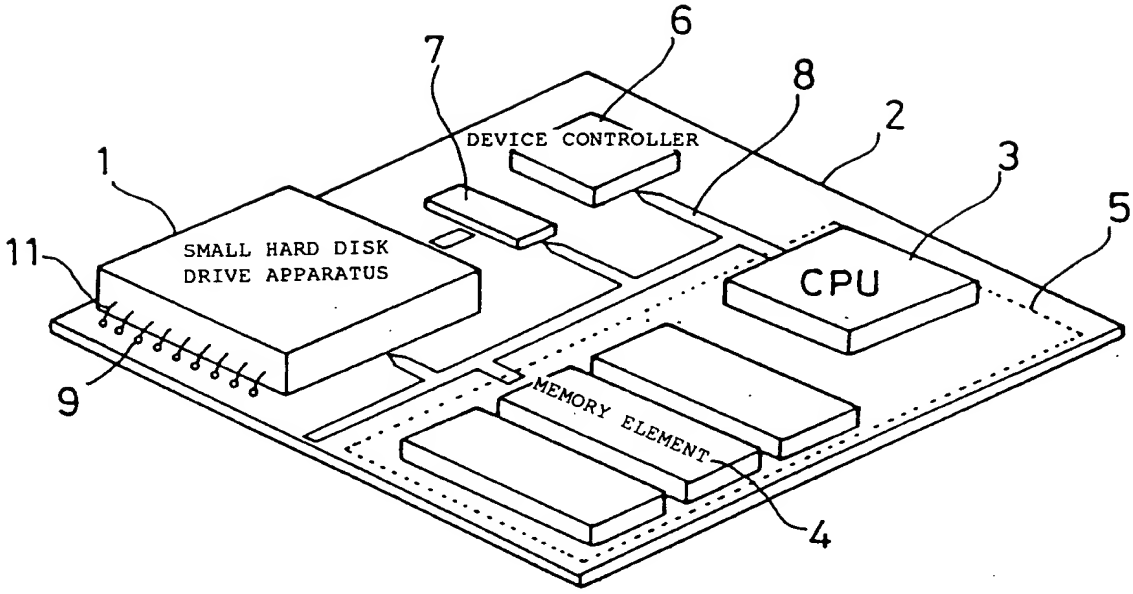
6
7
8
2
DEVICE CONTROLLER
1
3
5
11
SMALL HARD DISK
DRIVE APPARATUS
CPU
9
MEMORY ELEMENT
4

FIG. 2

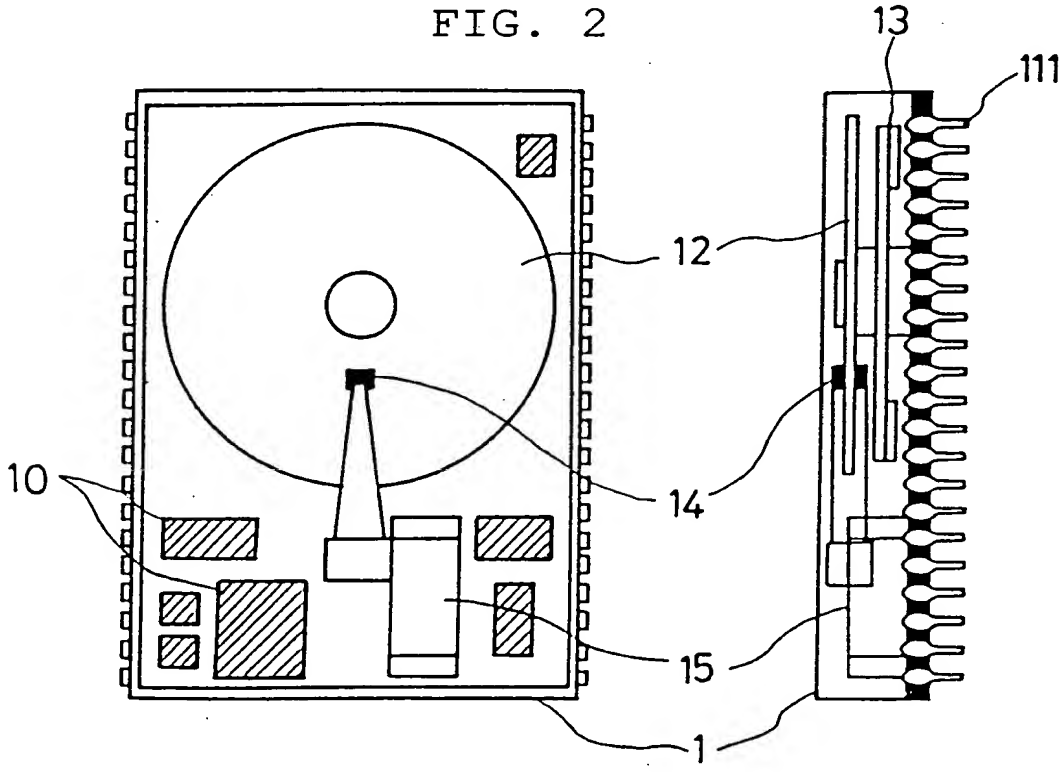
13
111
12
14
10
15
1

FIG. 3

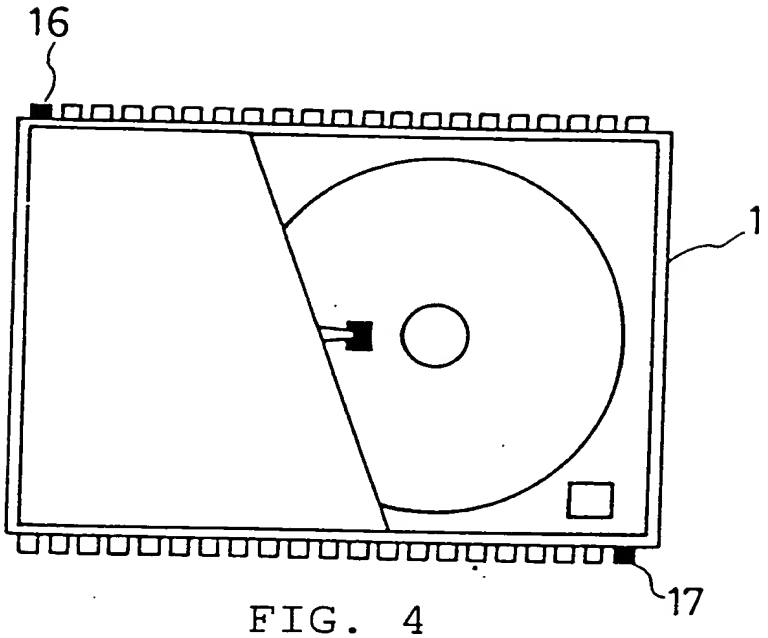

FIG. 4

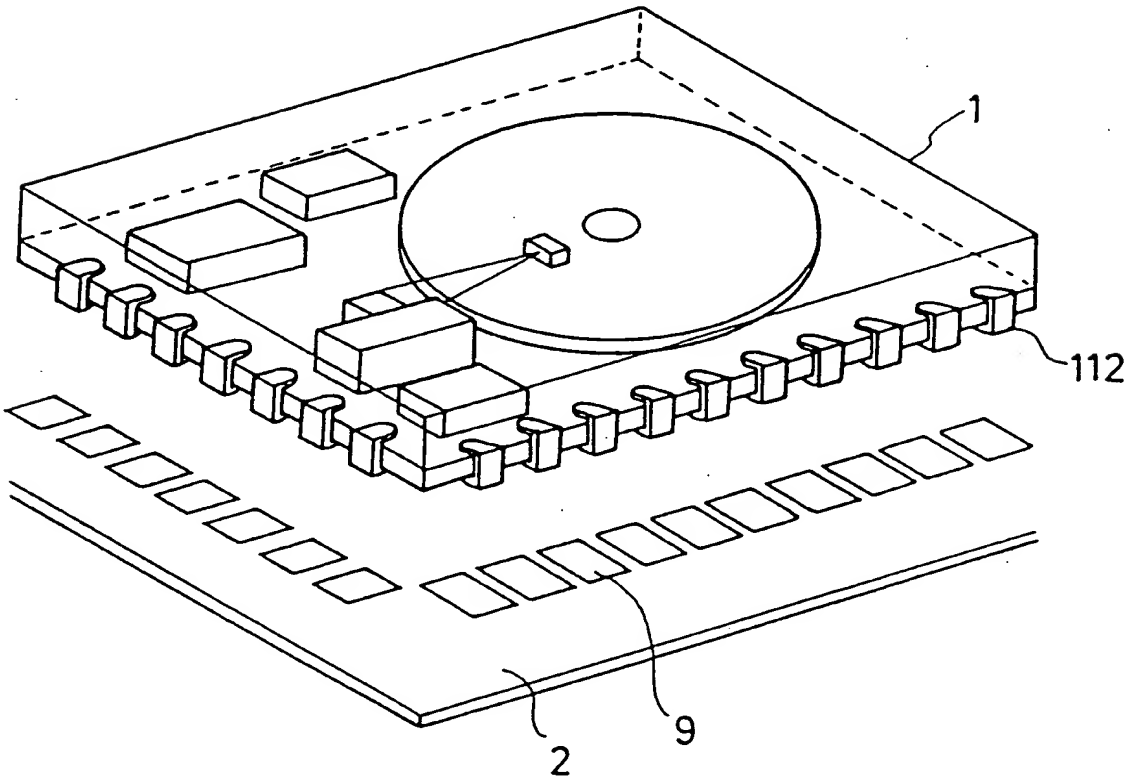

FIG. 5

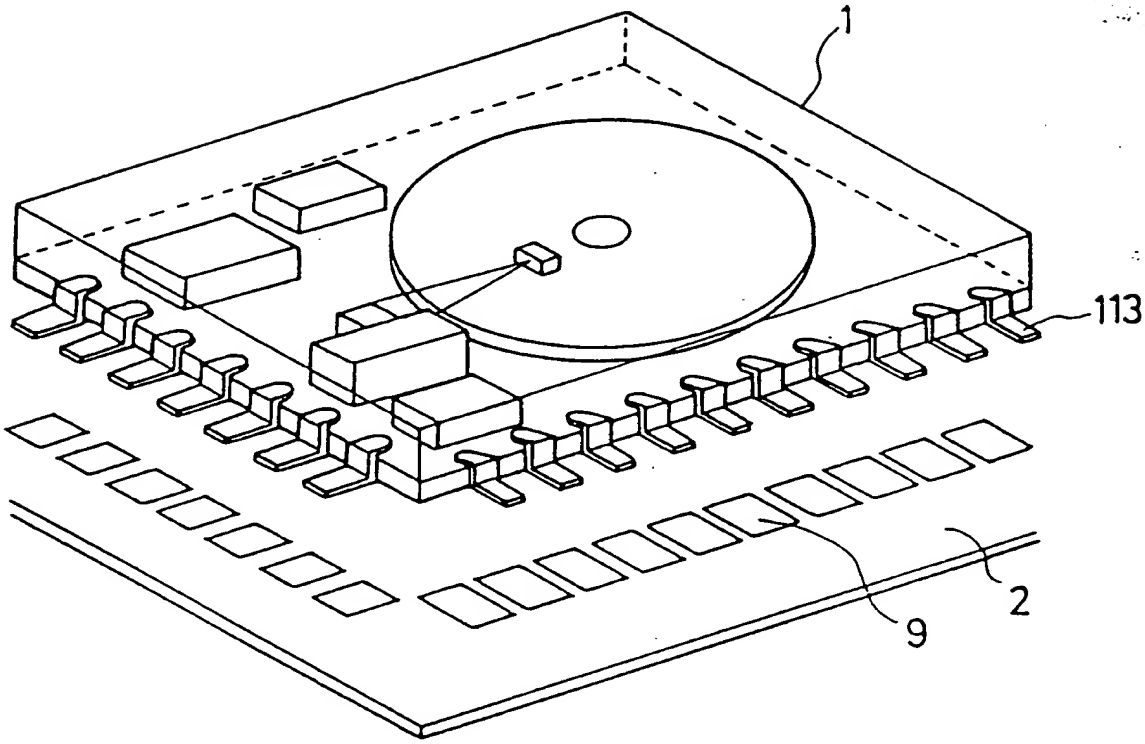

FIG. 6

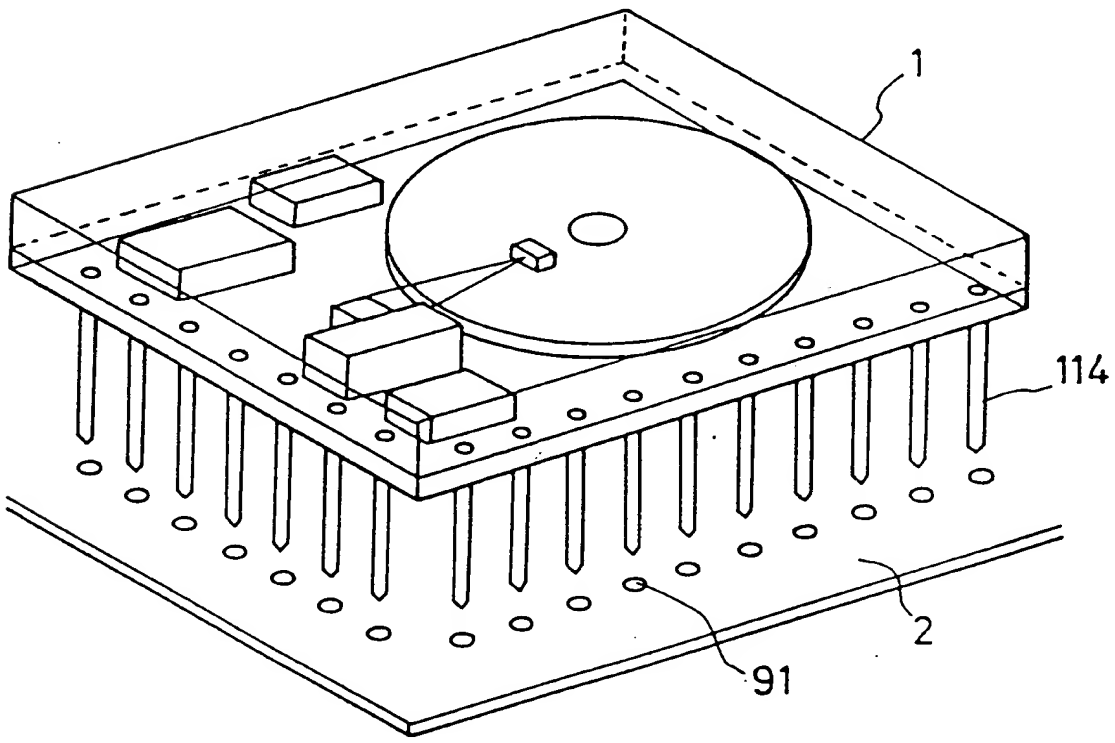

FIG. 8

Pin No	SIGNAL NAME	Pin No	SIGNAL NAME
01	GND	02	DB0
03	GND	04	DB1
05	GND	06	DB2
07	GND	08	DB3
09	GND	10	DB4
11	GND	12	DB5
13	GND	14	DB6
15	GND	16	DB7
17	GND	18	DBP
19	GND	20	GND
21	GND	22	GND
23	GND	24	GND
25	OPEN	26	TERM PWR
27	GND	28	GND
29	GND	30	GND
31	GND	32	ATN
33	GND	34	GND
35	GND	36	BSY
37	GND	38	ACK
39	GND	40	RST
41	GND	42	MSG
43	GND	44	SEL
45	GND	46	C/D
47	GND	48	REQ
49	GND	50	I/O

FIG. 7

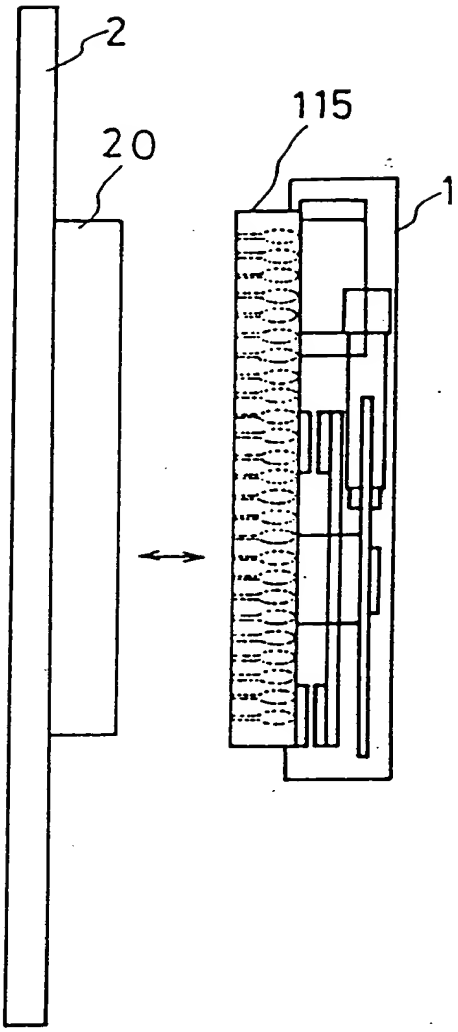

FIG. 9

Pin No	SIGNAL NAME	Pin No	SIGNAL NAME
01	ATN	02	DB0
03	BSY	04	DB1
05	ACK	06	DB2
07	RST	08	DB3
09	MSG	10	DB4
11	SEL	12	DB5
13	C/D	14	DB6
15	REQ	16	DB7
17	I/O	18	DBP

FIG.10

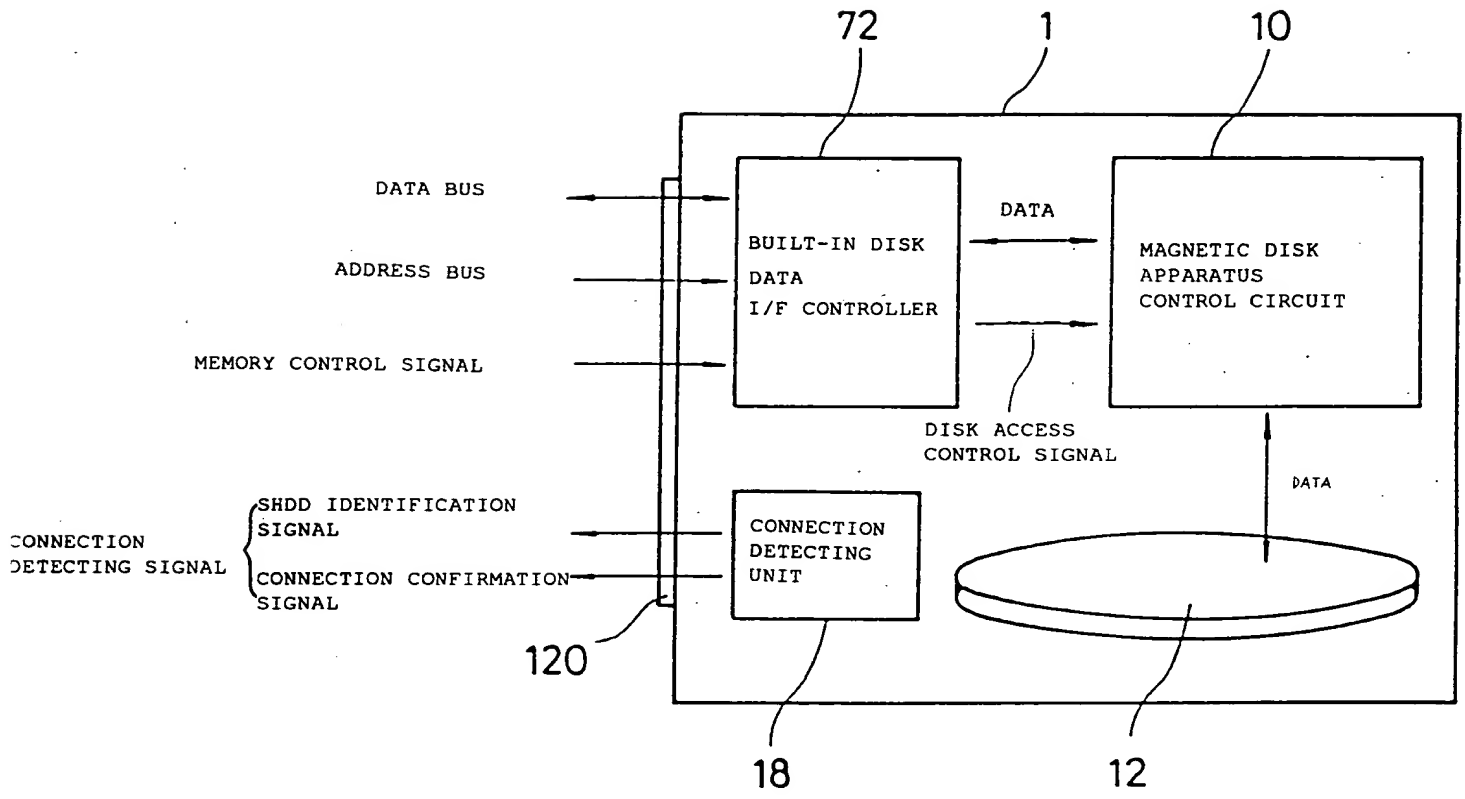
72
1
10
DATA BUS
ADDRESS BUS
MEMORY CONTROL SIGNAL
BUILT-IN DISK
DATA
I/F CONTROLLER
DATA
MAGNETIC DISK
APPARATUS
CONTROL CIRCUIT
DISK ACCESS
CONTROL SIGNAL
DATA
CONNECTION
DETECTING SIGNAL
SHDD IDENTIFICATION
SIGNAL
CONNECTION CONFIRMATION
SIGNAL
CONNECTION
DETECTING
UNIT
120
18
12

FIG.11

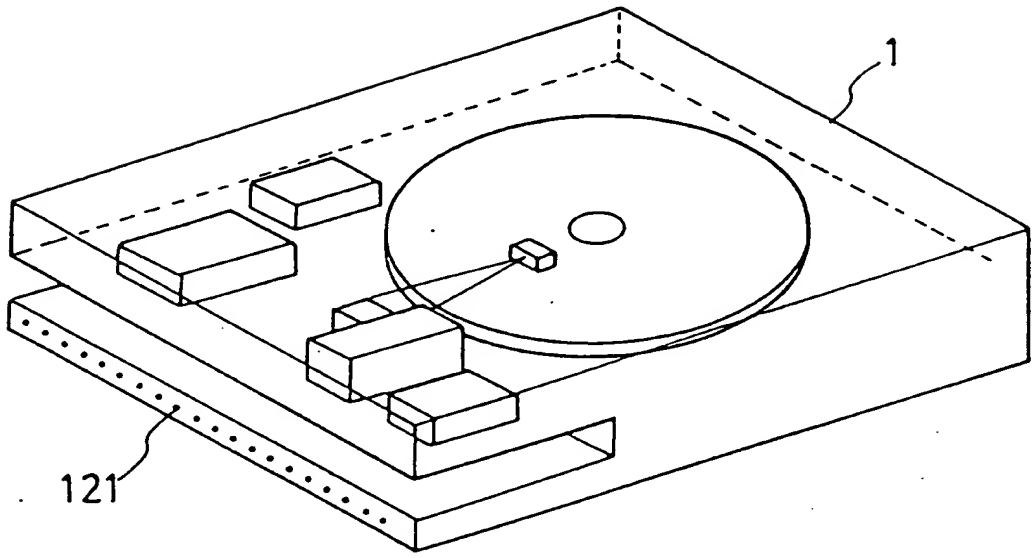

FIG.12

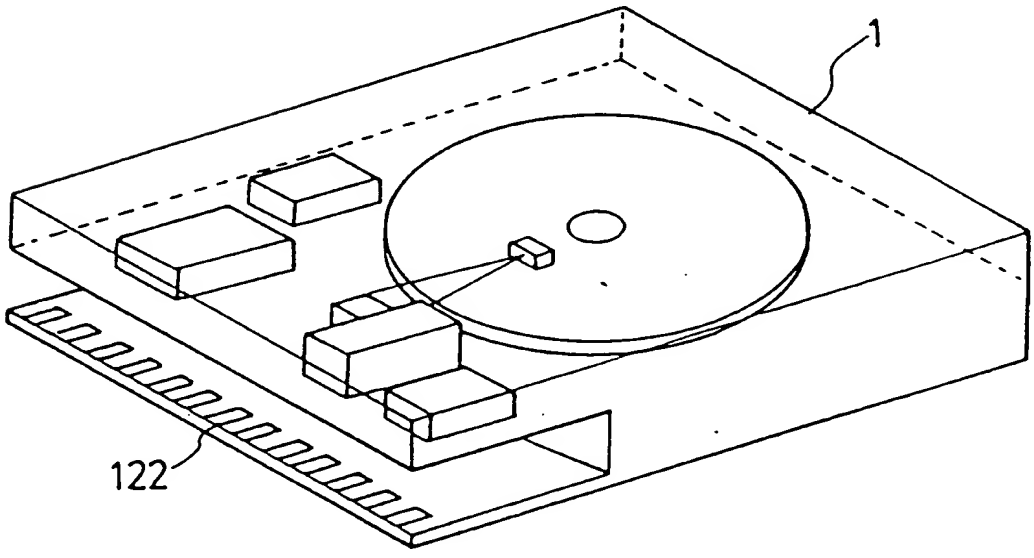

FIG.13

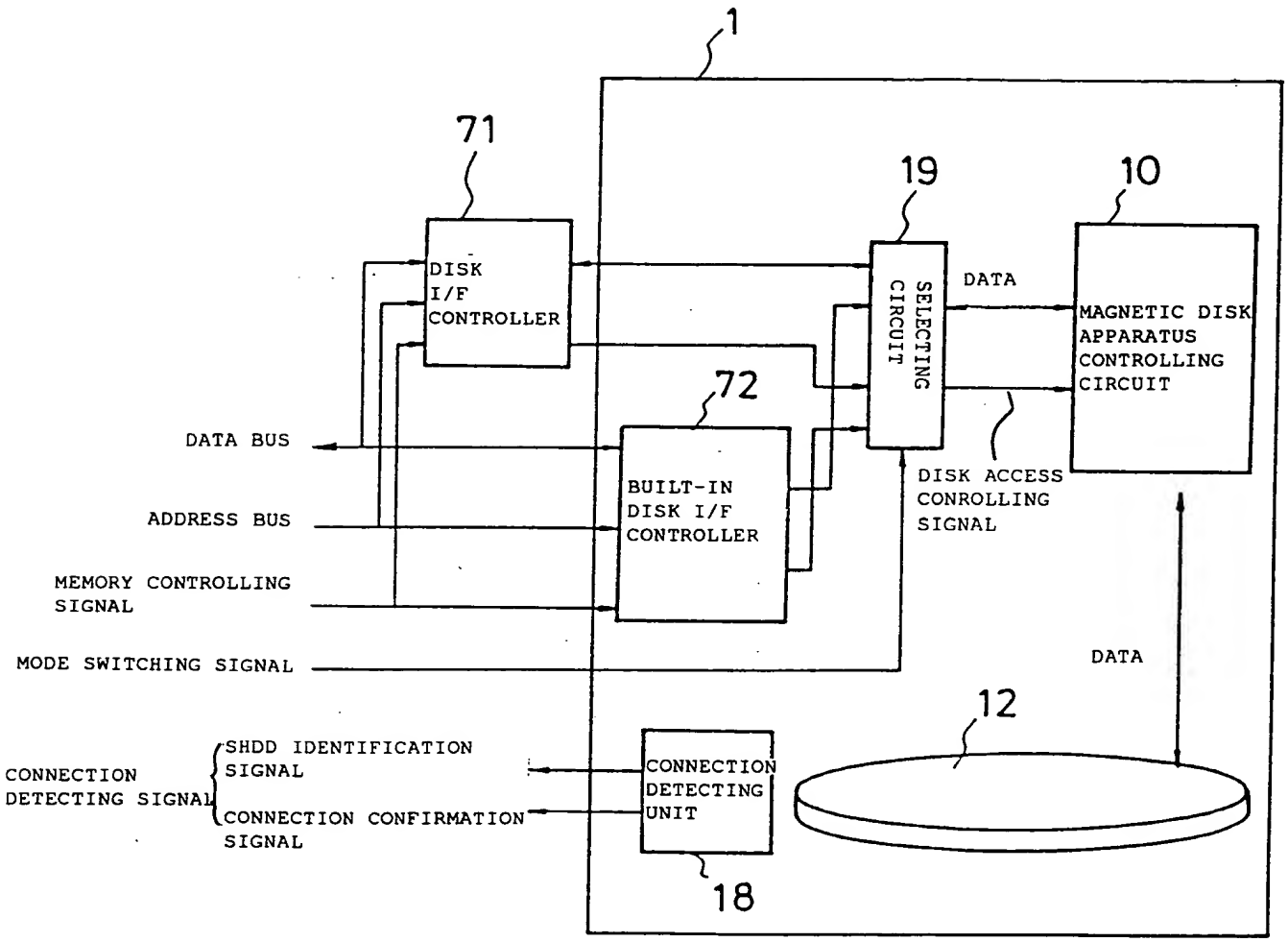
1
71
19
10
DISK
I/F
CONTROLLER
SELECTING
CIRCUIT
DATA
MAGNETIC DISK
APPARATUS
CONTROLLING
CIRCUIT
72
DATA BUS
BUILT-IN
DISK I/F
CONTROLLER
DISK ACCESS
CONROLLING
SIGNAL
ADDRESS BUS
MEMORY CONTROLLING
SIGNAL
MODE SWITCHING SIGNAL
DATA
12
CONNECTION
DETECTING SIGNAL
SHDD IDENTIFICATION
SIGNAL
CONNECTION CONFIRMATION
SIGNAL
CONNECTION
DETECTING
UNIT
18

FIG.14

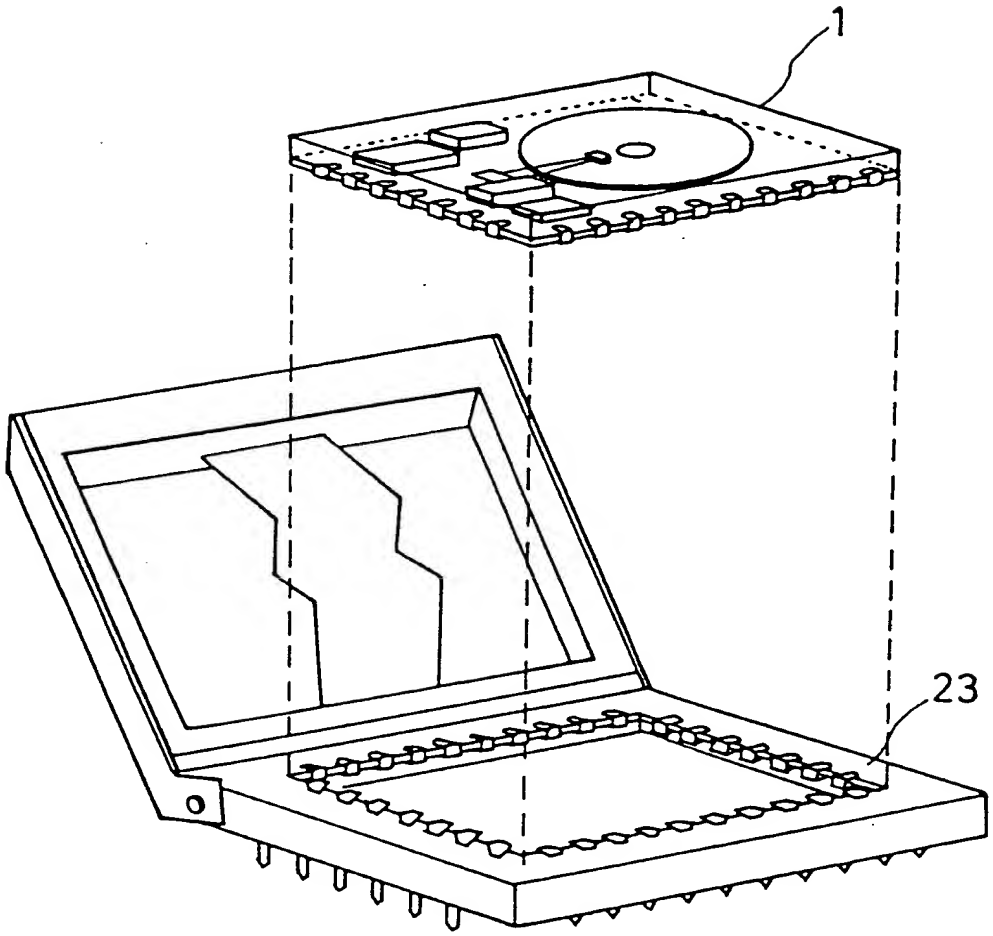

FIG.15

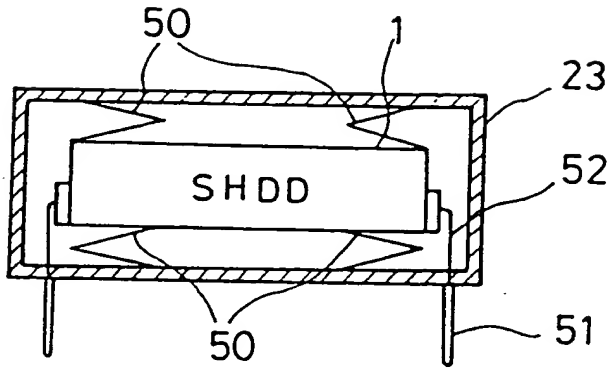

FIG.16

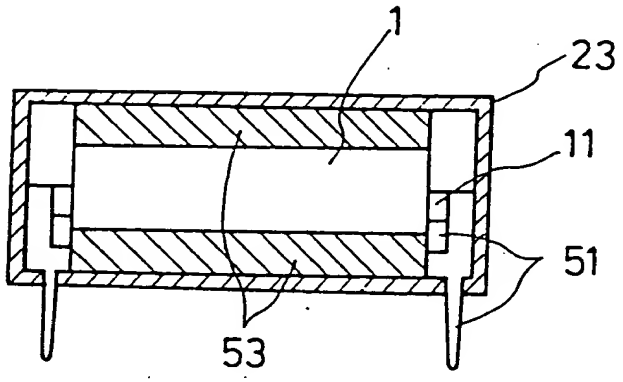

FIG.17

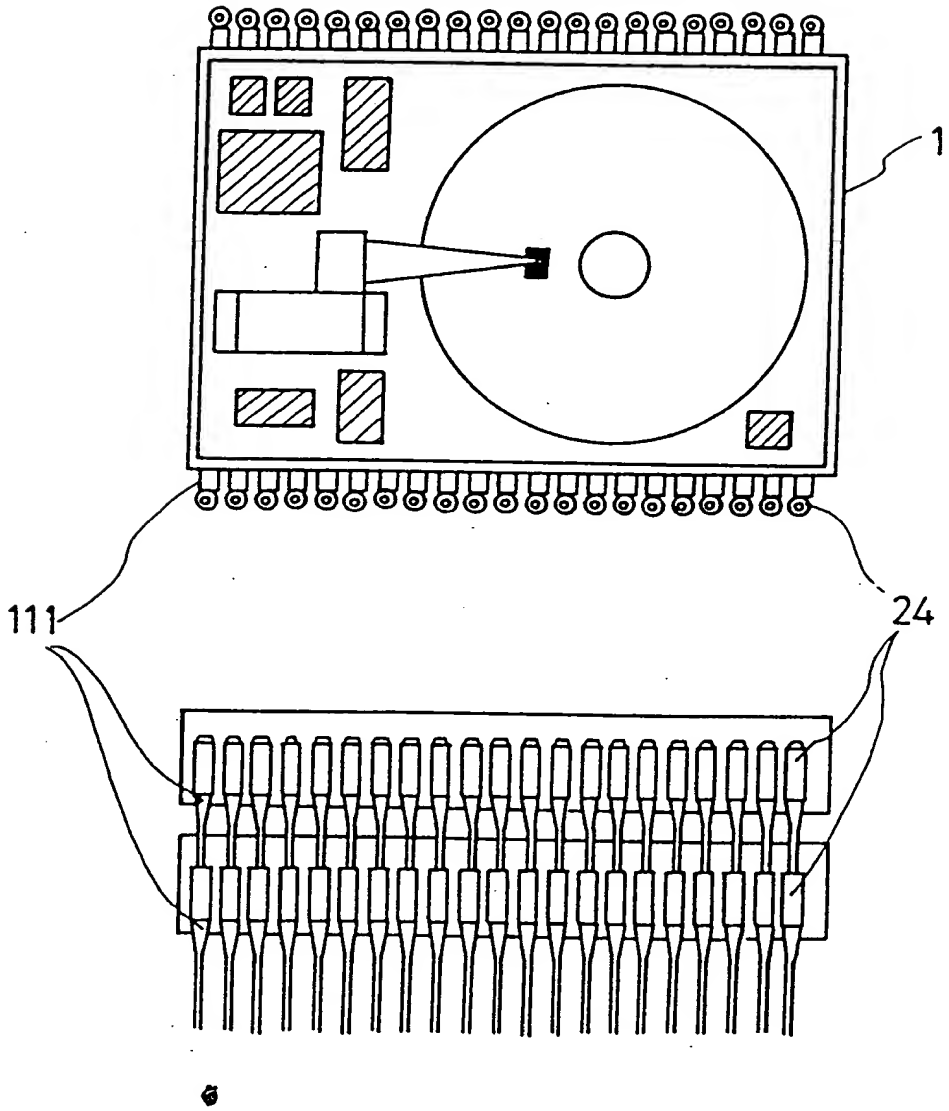

FIG.18